What is claimed is:

1   1.   A system for determining a natural color depth of a digital image,

2   comprising:

3   a color distance module determining color distances between each pair of

4   colors in a color palette stored for a digital color image;

5   a merge module selecting a closest neighboring color for each color in the

6   color palette separated by a substantially minimum color distance, and merging,

7   in iterative sequence, each color pair that is visually indistinct.

1   2.   A system according to Claim 1, further comprising:

2   an averaging module generating a weighted average of the colors in each

3   color pair that are visually indistinct.

1   3.   A system according to Claim 2, wherein the weighted average z is

2   calculated, in accordance with the equation:

3        $$z = \frac{[count(x) \times x] + [count(y) \times y]}{count(x) + count(y)};$$

4   where x and y are the colors in the color pair, and *count()* denotes the number of

5   occurrences of each color in the digital color image.

1   4.   A system according to Claim 1, wherein visual distinctness is

2   determined based on an output of a function f of visual area, in accordance with

3   the equation:

4        $$f(x) = \frac{c}{x + c(y_2 - y_1)^{-1}} + y_1;$$

5   where x is a visual area occupied by one of the colors in the color pair, y_1 denotes

6   a horizontal asymptote, y_2 denotes a y-intercept, and c represents a fitted curve

7   constant.

1   5.   A system according to Claim 4, further comprising:

2   a visualization module determining visual distinction Δ, in accordance

3   with the equation:

4

$$\Delta(x, y) = \begin{cases} \text{TRUE,} & \text{if } |x - y| \geq f(v(x)); \\ \text{FALSE,} & \text{if } |x - y| < f(v(x)); \end{cases}$$

5 where v is a visual area comprising a largest four-way block of contiguous pixels

6 of one of the colors in the color pair.

1   6.   A method for determining a natural color depth of a digital image,

2 comprising:

3   determining color distances between each pair of colors in a color palette

4 stored for a digital color image;

5   selecting a closest neighboring color for each color in the color palette

6 separated by a substantially minimum color distance; and

7   merging, in iterative sequence, each color pair that is visually indistinct.

1   7.   A method according to Claim 6, further comprising:

2   generating a weighted average of the colors in each color pair that are

3 visually indistinct.

1   8.   A method according to Claim 7, further comprising:

2   calculating the weighted average z, in accordance with the equation:

3
$$z = \frac{[count(x) \times x] + [count(y) \times y]}{count(x) + count(y)};$$

4 where x and y are the colors in the color pair, and $count()$ denotes the number of

5 occurrences of each color in the digital color image.

1   9.   A method according to Claim 6, further comprising:

2   determining visual distinctness based on an output of a function f of visual

3 area, in accordance with the equation:

4
$$f(x) = \frac{c}{x + c(y_2 - y_1)^{-1}} + y_1;$$

5   where x is a visual area occupied by one of the colors in the color pair, y_1 denotes

6   a horizontal asymptote, y_2 denotes a y-intercept, and c represents a fitted curve

7   constant.

1   10.   A method according to Claim 9, further comprising:

2   determining visual distinction Δ, in accordance with the equation:

$$\Delta(x,y) = \begin{cases} \text{TRUE,} & \text{if } |x-y| \geq f(v(x)); \\ \text{FALSE,} & \text{if } |x-y| < f(v(x)); \end{cases}$$

4   where v is a visual area comprising a largest four-way block of contiguous pixels

5   of one of the colors in the color pair.

1   11.   A computer-readable storage medium holding code for performing

2   the method according to Claims 6, 7, 8, 9, or 10.

1   12.   A system for reducing a color palette of a digital image to a natural

2   color depth, comprising:

3   a distance module selecting a neighboring color closest in color distance in

4   a color space for each unique color in the color palette of a digital image; and

5   a merge module merging the unique color and the closest neighboring

6   color, comprising determining visual distinctness of the unique color based on the

7   visual area occupied by the unique color in the digital image, and combining the

8   unique color and the closest neighboring color when visually indistinct and

9   reducing the color palette by replacing all occurrences of the unique color and the

10   closest neighboring color with the combined color.

1   13.   A system according to Claim 12, wherein selecting the closest

2   neighboring color and merging the unique color and the closest neighboring color

3   is repeated until no further colors in the color palette merge.

1   14.   A system according to Claim 12, further comprising:

2   a statistical module counting occurrences of the unique color, counting

3   occurrences of the closest neighboring color, and calculating a weighted average

4   of the unique color and the closest neighboring color to combine the unique color

5   and the closest neighboring color.

1   15.   A system according to Claim 12, further comprising:

2   a visual distinctness module evaluating the visual area occupied by the

3   unique color relative to color distances in the color space from other colors to

4   determine a threshold below which the unique color and any other such color are

5   visually indistinct.

1   16.   A system according to Claim 15, wherein visual distinctness is set

2   as occurring when the color distance between the unique color and the closest

3   neighboring color exceeds the threshold.

1   17.   A system according to Claim 15, wherein the color distance is

2   determined as a Euclidean distance in the color space.

1   18.   A system according to Claim 12, wherein the digital image is

2   received as an output from another color reduction process.

1   19.   A system according to Claim 12, wherein the digital image is

2   forwarded as an input to another color reduction process.

1   20.   A system according to Claim 12, further comprising:

2   a non-natural color depth color reduction process performing a color

3   reduction of the color palette of the digital image prior reducing the color palette

4   to a natural color depth.

1   21.   A system according to Claim 12, further comprising:

2   a compression module compressing the digital image following reduction

3   of the color palette to a natural color depth.

1   22.   A system according to Claim 12, wherein the color space is

2   selected from the group comprising CIELAB, RGB, sRGB, YUV, HSV, HSB,

3   and YCbCr.

1   23.   A method for reducing a color palette of a digital image to a

2   natural color depth, comprising:

3   selecting a neighboring color closest in color distance in a color space for

4   each unique color in the color palette of a digital image; and

5   merging the unique color and the closest neighboring color, comprising:

6   determining visual distinctness of the unique color based on the

7   visual area occupied by the unique color in the digital image; and

8   combining the unique color and the closest neighboring color when

9   visually indistinct and reducing the color palette by replacing all occurrences of

10   the unique color and the closest neighboring color with the combined color.

1   24.   A method according to Claim 23, further comprising:

2   repeatedly selecting the closest neighboring color and merging the unique

3   color and the closest neighboring color until no further colors in the color palette

4   merge.

1   25.   A method according to Claim 23, further comprising:

2   counting occurrences of the unique color;

3   counting occurrences of the closest neighboring color; and

4   calculating a weighted average of the unique color and the closest

5   neighboring color to combine the unique color and the closest neighboring color.

1   26.   A method according to Claim 23, further comprising:

2   evaluating the visual area occupied by the unique color relative to color

3   distances in the color space from other colors to determine a threshold below

4   which the unique color and any other such color are visually indistinct.

1   27.   A method according to Claim 26, further comprising:

2   setting visual distinctness as occurring when the color distance between

3   the unique color and the closest neighboring color exceeds the threshold.

1   28.   A method according to Claim 26, further comprising:

2   determining the color distance as a Euclidean distance in the color space.

1   29.   A method according to Claim 23, further comprising:

2   receiving the digital image as an output from another color reduction

3   process.

1   30.   A method according to Claim 23, further comprising:

2   forwarding the digital image as an input to another color reduction

3   process.

1   31.   A method according to Claim 23, further comprising:

2   performing a color reduction of the color palette of the digital image prior

3   reducing the color palette to a natural color depth.

1   32.   A method according to Claim 23, further comprising:

2   compressing the digital image following reduction of the color palette to a

3   natural color depth.

1   33.   A method according to Claim 23, wherein the color space is

2   selected from the group comprising CIELAB, RGB, sRGB, YUV, HSV, HSB,

3   and YCbCr.

1   34.   A computer-readable storage medium holding code for performing

2   the method according to Claims 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, or 33.